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Sir Arthur Everett Shipley

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Observations on Birds.

Our observations on a large number of recently dead or dying grouse impels us to believe that in many cases death is primarily caused by the presence of parasitic worms, either Cestodes or Nematodes in various parts of the alimentary canal.

Cestoda.

Conspicuous amongst the entozoa of the Grouse is *Davainea urogalli* (Modeer), which in the grouse is only found in the small intestine. This is the tapeworm known to sportsmen and to keepers; it indeed frequently protrudes from the hinder end of the alimentary canal and sometimes trails like a pennant behind a bird that is flying. Besides this we have very frequently a second genus and species of Cestode the *Hymenolepis microps* (Diesing) which we have for the first time recorded from the grouse, this occurs in the duodenum with a third species *Davainea cesticillus* (Molin), but as we have only found this twice it may be neglected in a consideration of the effects of the cestode parasites upon the health of the birds.

In this enquiry I propose to confine myself to the action of entozoa on the wall of the alimentary canal and having given a short, preliminary account of what happens in the grouse to consider the evidence which is accumulating of injury done to the human intestine, caecum and appendix by the presence of entozoa.

found in the smaller and younger swellings. In the earlier stages a cell-infiltration envelopes the head of the *Davainea* in the nodule. Moore dwells upon the wide prevalence of this disease and the chances of its being mistaken for tuberculous disease in fowls. He states that it "is highly probable that the total loss it occasions both from deaths and from the shrinkage of poultry products, due to the chronic course of the disease it produces, is very large."

Hymenolepis microps (Diesing).

We found the second tapeworm, which exists in any abundance in grouse, in September 1905. It had hitherto escaped the notice of the numerous observers who have for years been working at grouse disease. Its name is *Hymenolepis microps* (Diesing, 1850) and it lives in countless numbers in the duodenum, yet it is unrecognizable when alive. In this state the contents of the duodenum resembles a thick purée. If to this purée we add corrosive sublimate the tapeworms, which are so transparent when alive as to be invisible, slowly whiten and reveal themselves as countless fine opaque threads each with one end—the head end—sunk in the walls of the alimentary canal. *H. microps* is a very fine, fragile but long, worm attaining at times a length of 15 cms. and it consists of an enormous number of proglottides. The head like the head of *D. urogalli* has a rostellum and four suckers, but the rostellum is alone armed with hooks. These are very numerous, some 6 μ in length, very sharply pointed and shaped like slightly curved bayonets. In transverse sections of the duodenal wall of a grouse infested with these tapeworms, one sees the head "nuzzling" down between the villi.

NEMATODA.

Passing to the thread—or round—worms which infest the alimentary tract of grouse, here again we find three species, one of which, *Syngamus trachealis* von Siebold, is so rare as to be negligible; another species *Trichosoma longicolle* Rudolphi is so difficult to see that all previous observers overlooked it, and we ourselves did not find it for months, although when once found we had little difficulty in finding again and again; and a third species *Trichostrongylus pergracilis* (Jobbold) known to the older observers and the apparent cause of profound disease in the grouse.

Syngamus trachealis von Siebold, 1836.

Another case of the continuity of the lining membrane of an organ being destroyed is that caused by the *Syngamus trachealis* found in the trachea of poultry and pheasants. This so-called red- or forked-worm pierces through the wall of the trachea and actually clenches the teeth with which its mouth is provided in the cartilaginous tracheal rings. So close is the attachment that the body of the worm will rupture if when once firmly fixed attempts are made to pull it away from the tracheal wall. If the trachea contains septic organisms and the cartilage were easily infected by them a more efficient inoculating medium could not be devised.

Observations on other Vertebrates.

Before passing on to consider the relation of the nematodes to the wall of the human intestine and caecum I should like to draw attention to one or two striking cases of lesions caused by thread-worms in other Vertebrates.

The Horse.

Such an instance is the *Sclerostoma equinum* so often found in the colon and caecum of the horse. This nematode pierces the mucosa until it reaches the capillary blood vessels and then engorges itself upon the horse's blood. The walls of the alimentary canal infested with this parasite are dotted with small reddish ulcers which heal sooner or later according to the nature of the bacteria which have access to them. When the bacteria are pathogenic the ulcers are formed at the place of the lesion and here various forms of microbes are found[1]. These ulcerations can according to Weinberg extend until they attain an area of 23 mm. × 8 mm. In them the mucosa and often the sub-mucosa is destroyed and a marked infiltration of leucocytes, amongst which many bacteria occur, takes place in the deeper layers of the sub-mucosa. In other cases the ulcers are replaced by small abscesses some of which attain a considerable size (85 mm. × 33 mm.); they contain a fluid but there is little infiltration of leucocytes. These ulcers are especially common in horses that are wasting away and are attributed by

[1] Faure and Marotel (1902). I have not been able to see this Paper but I am indebted for a summary of it to Weinberg's article (1907). From this I have taken many references and many statements.

Oxyuris vermicularis (Linnaeus, 1767).

O. Seiffert (1908) draws attention to the lesions in the mucous membrane of the rectum caused by these very common worms and to the fact of the intestinal catarrh they frequently set up. Wagener (1904) found amongst the Peyer's patches of a hog, five years old, 15—20 small nodules which when investigated microscopically revealed the calcified remains of *Oxyuris* worms. He considered that the worms had penetrated into the follicles, formed ulcers there, and when the ulcers healed had undergone calcareous degeneration. Ruffer (1901) also records a number of tumours in the rectum of a man, the tumours varying in size from a pin's head to a walnut. The tumours contained ova of *Oxyuris*; since these could not have got there by themselves the probability is that they were laid *in situ* by some female which had penetrated the rectal wall. Fröhlich is quoted by Weinberg as describing a case in which he found 16 *Oxyuris*, all females, living surrounded by pus in a tumour in the peritoneum of a child of 11 years of age. Edens (1896) found the head of an *Oxyuris* in a nodule of a Peyer's patch in a child of seven years whose intestine presented the typical lesions of primary, intestinal tuberculosis. There are many more examples, but these seem to me sufficient to show that *Oxyuris* can and, not unfrequently, does perforate the wall of the alimentary canal.

Relation of entozoa to Appendicitis in Man.

The relations of this worm with appendicitis may now be considered. The worms live in the lower part of the small intestine, in the caecum and in the appendix vermiformis. When the eggs begin to develop in the fertilized female the worms leave the caecum and appendix and passing through the colon arrive at the rectum; here they may lay their eggs but most of them creep out of the body to lay them elsewhere.

Galli-Valerio (1903) has described a case of an appendix which had been perforated and which contained many Oxyurids, the tail of one of the male specimens was threaded through the mucosa and microscopic sections showed spaces resembling the perforation which were surrounded by an infiltrated zone infected with bacteria. Weinberg (1906, 1907) gives at length an account for which he is indebted to Dr Thevenard of a boy aged 11 years, who was after much suffering operated on for appendicitis. On examining the appendix about 1·5 cm. from the free end

:own, and it is found in all climates, though it is more abundant in arm climates than elsewhere.

The genus *Ascaris* has, in certain of its species, the power of ;taching itself to the inner lining of the wall of the alimentary tract. :uiart has described specimens of *A. conocephalus* from the intestine of dolphin: "profondement incrusté dans la muqueuse, s'y était taillé une)rte de cupule assez profonde," and Weinberg has reported the case of n Ascarid lightly attached to the duodenal mucous layer of an ape and t this point there was ulceration. The latter writer quotes a letter :om Dr Fontoynot, Professor at the School of Medicine, Tananarivo Madagascar), in which he says that *A. lumbricoides* is of extreme requency in the natives (Malgache), in whom, among other troubles, the /orms frequently set up a mild appendicitis. He states " chaque fois ue j'ai vu un indigène présenter du météorisme abdominal, de la)éritonie légère, ou mieux du péritonisme avec localisation manifeste de a douleur au point de MacBurney, et epâtement dans la fosse iliaque lroite, la santonine prise à la dose de 0·15 gr. a toujours fait évacuer un)lus ou moins grand nombre d'ascarides et, par ce fait, a toujours amené a cessation de tous les phénomènes appendiculaires." The further fact hat he states that with one exception he has not met with grave ippendicitis amongst the natives, to some extent explains the immunity)f the highly parasitized Chinese, an immunity which has led Martignon (1901) to doubt whether entozoa play any part in setting up appendicitis. Weinberg also recounts an observation made by Aldo Castellani on the extirpated appendix of a young girl, into which an *Ascaris* had penetrated and in which one half of its body was firmly fixed. Between the parasite and the walls of the appendix was a purulent fluid charged with *Bacillus coli*. Other cases of the impaction of the worm are recorded by Kelly and Hurdon (1905): by Bergmann (1890), in which case the *Ascaris* had bored through the walls of the appendix and attained the perivisceral cavity: Arboré-Rally (1900) regarded a severe case of appendicitis in a boy of 10 years as due to Ascarids: Triboulet (1901) regarded another case as due to Ascariasis: Schiller (1902) states that the disappearance of certain caecal abscesses after the expulsion of Ascarids supports the view that they were the cause of the disturbance and in this tends to confirm the views previously expressed by Czerny and Heddäus (1898); Schwankhaus (1901) found in the peritoneal cavity of a boy of 13, who had died of diffuse peritonitis, an *A. lumbricoides*, which had bored its way through from the appendix: Nason (1904) described a case in which an *Ascaris* inside the appendix had so coiled

ttached to the inner face of the intestinal wall that it required some light force to withdraw it, this was due to its head-end being sunk in he mucus and coiled or wrapped round the villi. He found no evidence f lesions nor any solution of the continuity of the mucosa. Since Vichmann's time methods of research have improved and attention ıas been more closely focussed on the problem. Weinberg, whilst .llowing that in many cases the whip-like fore-end of the body is imply hidden in the mucus, maintains also that "il y a des trichocéphales ıui sont si bien fixés qu'en essayant de les détacher ou arrive plutôt ı séparer le tronçon terminal de leur partie antérieure." In fact he naintains that the whip-worm is always fixed on the mucosa, and certainly some specimens we have at Cambridge confirm this statement. At times the anterior end passes through the mucosa and appearing again as a needle may be threaded through a curtain, at other times it hid its anterior end in a canal burrowed out in the mucous lining. Girard (1901, p. 265) has recorded finding two whip-worms in the extirpated appendix of a girl of eight, one worm had penetrated the mucosa and there was much inflammation about the lesion, numbers of mono- and polynuclear leucocytes and a copious bacterial flora were aggregated there. A similar inflammatory centre, surrounding the point of entrance of a whip-worm into the mucous layer of an idiot dead at the Vaucluse Asylum, has been described by Vigouroux and Collet (1905, p. 270). Kaposi (1902) attributes a case of an appendicitis to the intervention of *T. trichiurus*. Moore (1906, p. 364) has recorded a case of appendicitis in which a "small worm was found"..."identified by Dr Thursfield as *Trichocephalus dispar*." Oui (1906) found two specimens with their heads deeply embedded in the mucous layer in another appendix, and Kahane (1907) communicates the case of an appendix which on examination showed inflammation and in which were a number of specimens of *T. trichiurus*, some free and some embedded in the mucosa.

Amongst the most interesting cases are some recorded by Weinberg on the presence of nematode parasites in apes and monkeys. These animals are very subject to parasites and are very frequently infested with *T. trichiurus* as are also Lemurs. He gives a figure of the interior of the caecum of a *Macacus cynocephalus* which is riddled with scores of specimens of this worm. The monkey died after two days of fever and was at once examined, when all the organs were found congested. The caecum and colon contained hundreds of whip-worms, and histological investigation showed that the points of fixation of these worms were centres of inflammation which extended deeply into the wall of the

bundant in the intestines of typhoid patients except in children and hat in them *Ascaris* seems to take its place as an inoculating agent.

The recognition of this association is no new thing. Roederer and Wagler in 1792 gave the earliest account of the "morbus mucosus" or yphoid fever, and they attributed the epidemic to the presence of the arge number of intestinal worms (*Trichocephalus*) which on making autopsies were found in the alimentary tract. Pinel (1807) indicates that one should always suspect the presence of 'vers intestinaux' in cases of fevers of the mucous lining. Davaine has further noted the association of typhoid and worms, and other observers to the same effect are quoted by Guiart and Grimbert (1906).

An interesting confirmation of Guiart and Grimbert's views as to the part played by entozoa in typhoid fever is found in the following experiment of Weinberg (1906). Typhoid bacilli were given to two apes, one of which quickly died of septicaemia, the other survived repeated doses of the bacilli for 33 days, during which time its temperature rose at evening from 38·9° C. to 39·6° C. but there was nothing characteristic in the temperature chart. When the ape died (33rd day) the post mortem showed in the ileum a number of ulcerated Peyer's patches which presented the characteristic features of typical typhoid lesions in various stages of their evolution. The lower end of the duodenum and the upper end of the jejunum of this ape were full of a mass of tapeworms, some of which were found fixed at the level of the ulcerations. The caecum and the colon contained a great number of *Trichocephalus*. Examination of the blood and of the spleen by cultures demonstrated the presence of the typhoid bacillus and microscopic investigation of the ulcerations in the intestine confirmed the presence of the same germ in its walls; they also occurred in the small ulcerations which surrounded the point where the heads of the tapeworms were embedded. The authorities at the Pasteur Institute were satisfied that this was a true case of typhoid, and this is the more interesting as Grünbaum (1904) although he succeeded with an ape, failed to give a *Macacus* typhoid, though apparently Chantemesse and Ramond (1897) had succeeded previously. Soloukha more recently working under the same conditions, and with *B. typhosus*, failed to convey the disease to an ape. Weinberg concludes that success in his case was due to the fact that the burrowing into the mucosa of the taenia's head and suckers afforded a port of entry for the germs to the tissues, where they set up the ulcerations, and he states that there were masses of the

more which merit discussion, but these three are, from my point ew, the most important. Two of these, the *Oxyuris* and the *ocephalus*, are comparatively common, and the latter is probably more common than is usually recognized. I have given some es above as to its prevalence. The family Doctor knows how non *Oxyuris* is. Comparatively few children escape it and it ks the rich and the poor, the apparently well cared for and the ected, with complete indifference. Only a couple of months ago und three specimens of *Oxyuris* in the extirpated appendix of atient who was quite ignorant as were her parents that she oured these worms. Further I have confined my attention largely ppendicitis, there are, however, many other diseases whose presence ssociated with entozoa in the alimentary canal, e.g. certain forms iarrhoea; some of these have been described by Weinberg who investigated the relations of many more parasites to the intestinal than are considered here. All tell the same tale.

With the discovery of bacteria and the important work which has n done during the last forty or fifty years the grosser human parasites e been rather left in the shade. Before that time it was much more al to administer vermifuges from time to time. Many of the nerous ailments of children were treated by our medical grand- ners with antihelminthics, and even to-day Sir Patrick Manson ommends that in the tropics and in other places where the intestinal asites are common a course of santonin should be administered to ldren every six months. In spite of the great increase in our owledge and practice of Hygiene, care in our meat supply, etc. which s so materially lessened the number of cases suffering for instance m the pork- or beef-tapeworm, I am not sure that, as regards ner entozoa, whose entrance into the body is less easily controlled, we ep the inside of our digestive system as clean as our ancestors kept eirs. But times are changing, and increasing attention is being paid what I am convinced is a serious factor in certain diseases. The atter is one which in England has received so far but little attention. ooking through the list of my "cloud of witnesses" hardly an Anglo- axon name occurs. Our knowledge of the relations of the parasite to ne intestinal wall is derived mostly from Italian, French and German ources. In the United States however there is at least one voice ying in the wilderness. In Professor H. B. Ward's (1907) careful onsideration of entozoa as germ carriers and germ inoculators, he says

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